

Lecture 22

I. Introduction

- A. Water microbiology is the _____. This is done to determine what organisms are present and if they are helpful or harmful.
- B. The safety of water for drink and contact is the main reason for _____. We must know if the water will cause harm to us or the environment. Some microorganisms can actually reduce the amount of environmental damage. We treat drinking water to make it potable.

II. Harmful organisms (bacteria, parasites, and viruses)

- A. _____ may affect as few as 1 or 2 people, or they may affect enough people to reach epidemic proportions. Luckily, the Safe Water Drinking Act and the _____ help keep us safe. Water treatment is not without flaws, so it is still a _____ that drinking water is safe, especially with the increased number of HIV/AIDS patients.
- B. Water contamination from _____ introduces into the water:
1. Pathogenic bacteria (mostly enteric or GI tract)
 - i. *Vibrio cholera*, which causes cholera
 - ii. _____, including b. *Salmonella typhi*
 - iii. *Cyanobacteria*, which may be a risk factor in cancer
 - iv. *Mycobacterium*
 2. _____, including the “super bugs” *Cryptosporidium* and *Giardia*
 3. Viruses, including hepatitis viruses

III. Screening for pathogens

- A. It is _____ to screen for enteric pathogens (e.g. *Shigella* and _____) for several reasons:
1. These pathogens enter the water supply _____ because not everyone is infected and shedding them continuously.
 2. Most enteric pathogens are not stable in the environment, therefore they _____.
 3. These pathogens are generally _____ so they may _____.
 4. _____ are required to culture enteric pathogens.

B. Due to these problems associated with finding pathogens in large volumes of water, we will instead look for _____ whose presence indicates fecal contamination. The most common group of these indicator organisms are called _____.

C. Coliforms are _____ that are present in the _____ of every warm-blooded animal. They are defined as aerobic or facultative anaerobic Gram-negative rods that do not form spores, but do _____. The _____ than enteric pathogens for several reasons:

1. Animals and humans _____ in their GI tract.
2. They are _____ in feces



3. Their presence in water will indicate fecal contamination, which suggests the possibility of pathogen contamination.

4. Coliforms _____ in water and are much _____ in the lab.

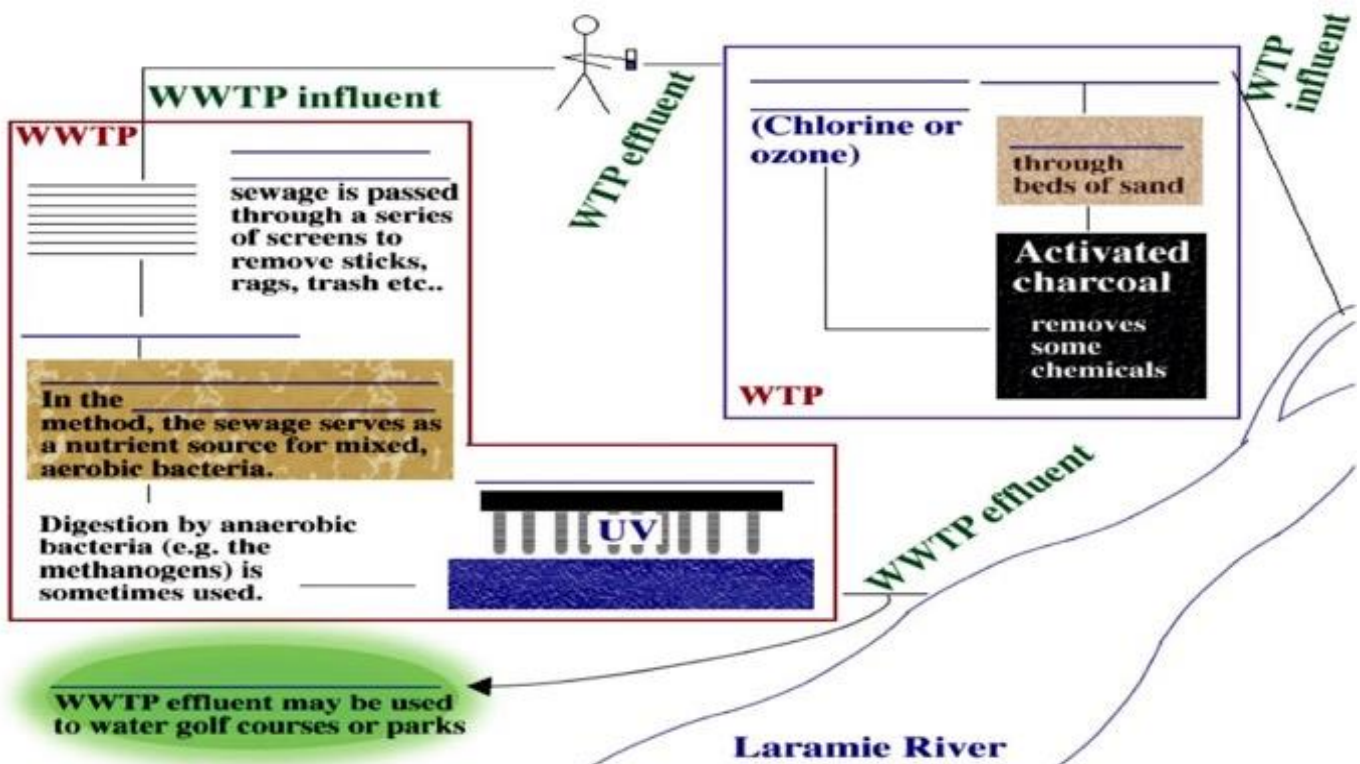
D. The detection of coliforms is complicated by the fact that _____. In fact, some are commonly found in the environment. Because of this, we commonly distinguish coliforms biochemically, to determine _____ using the _____.



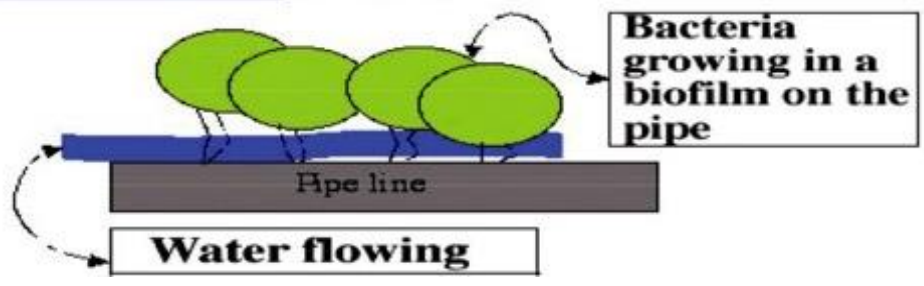
IMViC: _____

Organism	Indole	MR	VP	Citrate
Fecal coliforms (<i>Escherichia coli</i>)	+	+	-	-
Non-fecal coliforms (<i>Enterobacter aerogenes</i>)	-	-	+	+

IV. We will screen wastewater treatment plan (WWTP) influent and effluent, Laramie River water, water treatment plant (WTP) influent and effluent, and drinking water for the presence of coliforms.



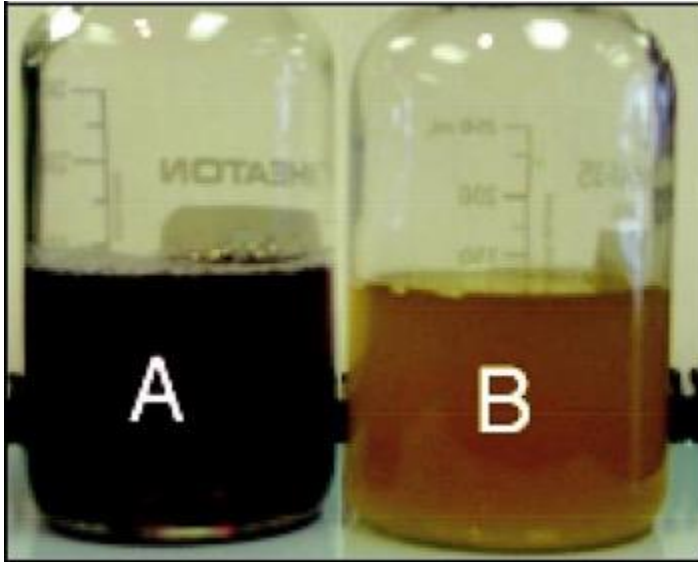
* _____ are one main reason for _____ of water.



V. Tests for coliforms

A. The _____

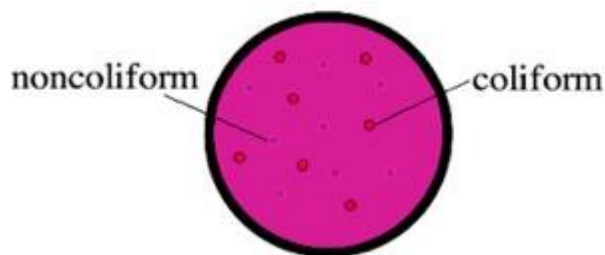
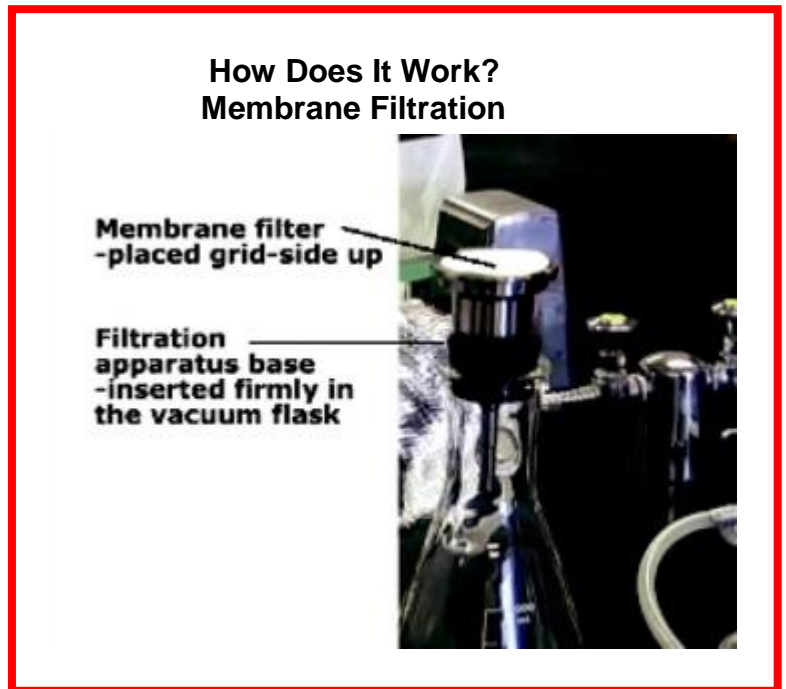
1. The PA is used to quickly examine for the presence of coliforms. This test is able to detect _____.
2. The PA broth contains _____ and a pH indicator that will change from a purple color to a _____ from the fermentation of lactose.



Knowledge check
Which water sample
contains at least 1
coliform?

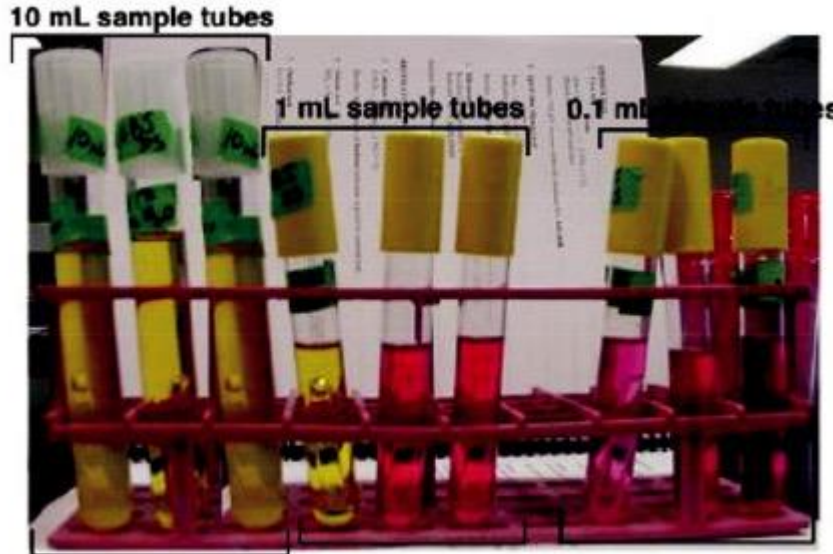
B. The _____ is a test that may be used to assay a _____ and allow us to _____ the number of coliforms in that sample. (See How Does It Work, right)

1. The water is passed through a 0.45 micron _____.
2. The filter is then placed on a selective and differential medium, usually EMB or Endo agar, which allows for identification of coliforms.
 - i. Endo media contains sodium sulfite and basic fuchsin to inhibit the growth of _____ organisms. Coliforms that ferment lactose form red or pink colonies that may be _____.



D. The Multiple Tube Fermentation Method is a test that is performed in three stages.

1. _____ uses a _____ that will be used to determine the presence of lactose fermenting bacteria in the sample. The nine inoculated lactose broth tubes will also enable us to _____ the amount of coliforms present in our sample by using the most probably number, or MPN, table located on page 127.



Profile: _____

How many coliforms/100 mL are present in this sample?

2. _____ is performed by inoculating MacConkey agar that contains MUG (4-Methylumbelliferyl- β -D-glucuronide). Selected Gram-negative colonies that ferment lactose turn bright pink; if the enzyme β - _____ is present, it will hydrolyze MUG to form a compound that _____ under long-wavelength UV. Because 96-97% of *E. coli* strains produce β -glucuronidase, this test is said to verify *E. coli* colonies.¹

3. _____ is done by selecting a lac+, fluorescent colony from the MacConkey/MUG plate and _____ to verify lactose fermentation. Also, the same colony should be stained to verify the Gram-negative, _____ character.

E. These tests are done on numerous bodies and sources of water _____.

VI. Other microbiology applications in water treatment

A. Biosensing is one of the new breakthroughs in microbiology. Korean scientists are using _____ containing the lux operon to indicate if there has been a failure in wastewater treatment.

B. Britain has the Microtox System, which uses *Photobacterium* directly to detect pollutants. They can't _____

C. *Pseudomonas* expressing _____ and other genes encoding toluene or benzene recognition will fluoresce in presence of these pollutants.

1. American Society for Microbiology, Microbe Library (2009)